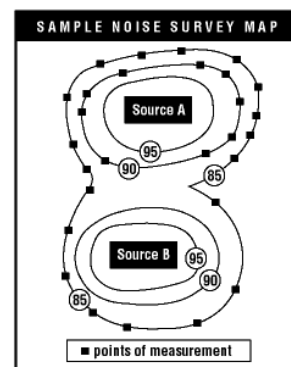


BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH96200
	REVISION FINAL Rev. 5
SUBJECT: Noise Measurement Principles: Area Surveys	DATE 04-09-04
	PAGE 1 OF 16

Contents

- 1.0 Purpose/Scope**
- 2.0 Responsibilities**
- 3.0 Definitions**
- 4.0 Prerequisites**
- 5.0 Precautions**
- 6.0 Procedure**
- 7.0 Implementation & training**
- 8.0 References**
- 9.0 Attachments**
- 10.0 Documentation**



1.0 Purpose/Scope

This procedure provides a standardized method for conducting area surveys with direct reading meters. It should be used in conjunction with the SBMS Subject Area *Noise and Hearing Conservation* and an *Instrument Operation* procedure in the series IH96300-IH96699.

An area survey meter, known as a Sound Pressure Level meter (SPL) should be used to determine baseline noise levels and area noise levels. Survey meters are designed for conducting noise surveys to determine the need for area warning posting, locate problem-noise sources, and measuring the effectiveness of engineering controls. It can be used as a screening tool to determine the need for personal monitoring and to sketch isometric lines for control area delineation.

Generally, employee exposure assessments should be made with a noise dosimeter. However, an area survey meter can be used in limited situations for employee exposure assessments, such as for operations that are of short duration (15 to 30 minutes) and that involve limited employee movement so that the meter can measure the actual employee exposure. In these cases, the meter reading must be observed and recorded over the entire time of exposure.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure		NUMBER IH96200
		REVISION FINAL Rev. 5
SUBJECT:	Noise Measurement Principles: Area Surveys	DATE 04-09-04
		PAGE 2 OF 16

2.0 Responsibilities

- 2.1 Personnel that perform exposure monitoring with this procedure are responsible to follow all steps in this procedure.
- 2.2 The data collected using this meter must have an appropriate evaluation of the hazard and risk by a skilled Industrial Hygiene professional.

3.0 Definitions

- 3.1 *ACGIH*: American Conference of Governmental Industrial Hygienists
- 3.2 *Decibel (dB)*: A non-dimensional unit used to express sound pressure levels. It is the log of the ratio of the measured sound pressure level to a reference level.
 - *dBA*: A sound pressure level in decibels made on the A-scale of a sound level meter. This unit of measure approximates the response of the human ear.
 - *dBc*: Sound pressure based on a nearly flat, non-weighted scale.
- 3.3 *Frequency*: The number of cycles completed by a periodic quantity in a unit time. Unit, hertz (Hz) measures cycles per second.
- 3.4 *Impulse or Impact Noise Levels*: Variations in noise levels that involve peak levels spaced at periods of greater than one per second. Where the intervals are less than one second, it should be considered a continuous noise source.
- 3.5 *Occupational Exposure Limit (OEL)*: The maximum time weighted average (TWA) exposure permitted for employee exposure, based on the less of the OSHA Permissible Exposure Limits (PEL) or ACGIH Threshold Limit Value (TLV):

OSHA exposure levels are calculated on a 5 dB doubling rate, whereas ACGIH utilizes a 3 dB doubling rate (for each drop of 3 dB in the average noise measurement double the allowable work time).

Table A: OSHA PEL & ACGIH TLV:

Duration/Day			OSHA PEL (dBA)	ACGIH TLV (dBA)
Hours	Minutes	Seconds		
24	1440			80
16	960			82
8	480		90	85
4	240		95	88
2	120		100	91
1	60		105	94
½	30		110	97

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure		NUMBER IH96200
		REVISION FINAL Rev. 5
SUBJECT:	Noise Measurement Principles: Area Surveys	DATE 04-09-04
		PAGE 3 OF 16

Duration/Day			OSHA PEL (dBA)	ACGIH TLV (dBA)
Hours	Minutes	Seconds		
¼	15		115	100
1/8	7.5			103
	3.75			106
	1.88			109
	0.94			112
		28		115
		14		118
		7.03		121
		3.52		124
		1.76		127
		0.88		130
		0.44		133
		0.22		136
		0.11		139
*No exposure to continuous or intermittent noise levels in excess of 140 dBC peak should be allowed				

4.0 Prerequisites

4.1 Steps prior to using this procedure:

- 4.1.1 Training for hazards other than noise may be needed for entry into restricted areas (check with ESH Coordinator or FS Representative for the facility).
- 4.1.2 Noise and Hearing Conservation Training and a Baseline audiogram is needed if the exposure to the person performing the survey will be in excess of the OSHA Permissible Exposure Limits (PEL) or ACGIH Threshold Limit Value (TLV), which ever is less (see Table A).

4.2 Area Access:

- 4.2.1 Contact the appropriate Facility Support Representative or FS Technician to obtain approval to enter radiological areas.
- 4.2.2 Verify with the appropriate Facility Support Representative or FS Technician if a *Work Permit* or *Radiological Work Permit* is needed or is in effect. If so, review and sign the permit.
- 4.2.3 Use appropriate PPE for area.

5.0 Precautions

5.1 Hazard Determination:

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH96200
	REVISION FINAL Rev. 5
SUBJECT: Noise Measurement Principles: Area Surveys	DATE 04-09-04
	PAGE 4 OF 16

- 5.1.1 The operation of an area survey meter does not cause exposure to any chemical, physical, or radiological hazards. The meters do not generate Hazardous Waste.
- 5.1.2 By its very nature, a noise survey meter may be used in areas where excessive noise levels exist or are suspected to be present. Exposures to noise levels above the PEL and/or TLV may cause temporary or permanent hearing loss.
- 5.1.3 The meters used in this procedure are light 9less than 2 pounds (1Kg) and do not pose an ergonomic hazard.

5.2 Personal Protective Equipment:

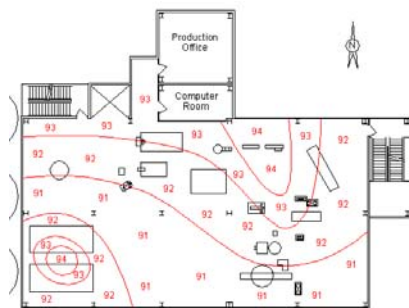
- 5.2.1 In areas where noise levels exceed the *Occupational Exposure Limit (OEL)*, hearing protection should be worn. The hearing protection should be able to reduce the noise levels below the OEL. See IH96150 Attachment 9.2 for Guidance on Hearing Protection Devices and their protection factors (Noise Reduction Ratio, NRR).
- 5.2.2 Additional PPE: Other appropriate PPE for hands, feet, skin, head, or eyes may be needed for the area being entered. Check with your FS Representative.

6.0 Procedure

- 6.1 **Operate the meter as per the BNL Instrument Operation SOP.**
 - 6.1.1 Perform a Battery Check prior to use and at least once every half hour of use.
 - 6.1.2 Warm-up the meter as per the Instrument Operation SOP.
 - 6.1.3 Pre-calibrate (i.e. single point operational accuracy check) the meter as per the Instrument Operation SOP. BNL requires daily calibration to a portable calibrator. Daily calibration serves as a Bump check of the meter operation pre and post testing.
 - 6.1.4 Select the desired weighting to A, B, C or FLAT (see Attachment 9.1) and the appropriate broadband weighting or octave band.
 - Employee exposure screening measurements should be taken on dBA.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure		NUMBER IH96200
		REVISION FINAL Rev. 5
SUBJECT:	Noise Measurement Principles: Area Surveys	DATE 04-09-04
		PAGE 5 OF 16

- Engineering and source characterization should be taken on dBC.
- 6.1.5 Select the desired detector response rate: FAST, IMP, PEAK, or SLOW. (Employee exposure measurements should be taken on SLOW.)
- 6.1.6 If appropriate, conduct an octave band analysis (OBA) for each frequency. OBAs are typically done for engineering measurements and are most useful if done on dBC weighting and SLOW response.
- 6.2 **Operator Position:** Preferably the operator should be further from the sound source than the microphone and positioned to reduce reflection of the sound to the meter. Hold the meter at arms length, not close to the body.
 - 6.2.1 Do not stand between the sound source and microphone.
 - 6.2.2 Do not place the hand within 12 cm (5 inches) of the microphone during measurements.
 - 6.2.3 Take measurements at the employee's ear level (whether sitting, standing or bending) to estimate personal exposures and to locate isometric lines of noise intensity on a sketch for defining area levels (i.e., a plot of noise levels on the floor plan, a.k.a. isopleths).
 - 6.2.4 Post-calibrate (i.e. single point operational accuracy check) the meter as per the Instrument Operation SOP.
- 6.3 **Recording readings:**
 - 6.3.1 Use a *BNL Direct Reading Sampling Instrument Form* to record readings (See Attachment 9.3).
 - 6.3.2 Return meter and original sampling form to the SHSD IH Laboratory.
 - 6.3.3 Ensure that a copy of any hazard evaluation report written by a competent person on the survey is sent to the IH Laboratory and the Occupational Medicine Clinic.
 - 6.3.4 The IH Group will maintain a copy of sampling results for at least 75 years.
- 6.4 **Results interpretation:**
 - 6.4.1 A competent person should write a hazard evaluation report that evaluates the



Typical Isopleth Map

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH96200
	REVISION FINAL Rev. 5
SUBJECT: Noise Measurement Principles: Area Surveys	DATE 04-09-04
	PAGE 6 OF 16

survey data and summarizes the potential for occupational exposure and compliance with OSHA and ACGIH Occupational Exposure Limits (see Table A).

- 6.4.2 Ensure that a copy of the hazard evaluation report is sent to the IH Laboratory and is included in the ESHQ Directorate Recordkeeping system under *IH96SR*.
- 6.4.3 Ensure that a copy the written hazard evaluation report is sent to the Occupational Medicine Clinic with the worker(s) BNL Life Number(s) noted.
- 6.4.4 The hazard evaluation report and/or an *Employee Notification Form* (Attachment 9.4) must be used to inform all employees whose monitoring results indicate exposure above the OELs.
- 6.4.5 Complete an Attachment 9.5 for data entry and return the form to the IH Laboratory.

7.0 Implementation & Training

- 7.1 Use of this SOP and an *Instrument Operation SOP* for a particular meter is limited to:
 - 7.1.1 Persons who act under the direction of a competent hazard assessment person
 - 7.1.2 Persons who have demonstrated the competency to satisfactorily use the procedures and meter, as evidenced by experience and training, to the satisfaction of their supervision or existing qualification criteria set by their organization.
 - 7.1.3 IH Group personnel qualification is documented in the JPM associated with IH96120.

8.0 References

- 8.1 BNL SBMS Subject Area *Noise and Hearing Conservation*
- 8.2 OSHA Noise/Hearing Conservation Standard 29CFR1910.95.
- 8.3 NIOSH Criteria for a Recommended Standard-Occupational Noise Exposure, 1998
- 8.4 ACGIH American Conference of Governmental Industrial Hygienists Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices 2004.
- 8.5 ANSI S1.13: Methods for the Measurement of Sound Pressure Levels.

The only official copy is on-line at the SHSD IH Group website.
Before using a printed copy, verify that it is current by checking the document issue date on the website.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH96200
	REVISION FINAL Rev. 5
SUBJECT: Noise Measurement Principles: Area Surveys	DATE 04-09-04
	PAGE 7 OF 16

9.0 Attachments

- 9.1 *Theory of Noise Measurements*
- 9.2 *BNL Program Administrator Guidance on Hazard Assessment and Exposure Monitoring*
- 9.3 *BNL Direct Reading Sampling Instrument Form*
- 9.4 *Employee Notification Form*
- 9.5 *IH Database Entry form*

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure		NUMBER IH96200
		REVISION FINAL Rev. 5
SUBJECT:	Noise Measurement Principles: Area Surveys	DATE 04-09-04
		PAGE 8 OF 16

10.0 Documentation

Document Review Tracking Sheet		
PREPARED BY: <i>(Signature and date on file)</i> C. Kramer Author Date 02/16/01	REVIEWED BY: <i>(Signature and date on file)</i> J. Peters SHSD IH Group Date 02/20/01	SHSD Approved By: <i>(Signature and date on file)</i> R. Selvey SHSD IH Group Leader Date 02/22/01
RCD Facility Support Procedure Committee Review 04/10/10		RCD Approved By / Date:
Filing Code: IH52QR.01	DQAR Date	Effective Date: 02/23/01

Periodic Review Record		
Date of Review	Reviewer Signature and Date	Comments Attached
03/09/01	<i>(Signature and date on file)</i> R. Selvey	Renumbered IH-FP-1.2 to new system IH96200. No other changes necessary.
04/11/01	<i>(Signature and date on file)</i> R. Selvey	Revised to include RCD Facility Support Procedure Committee Review comments.
04/26/01	<i>(Signature and date on file)</i> R. Selvey	Added Attachment 8.2: BNL Program Administrator Guidance on Hazard Assessment and Exposure Monitoring
05/08/01	<i>(Signature and date on file)</i> R. Selvey	Referred to IH96150 for NRR calculations in 5.2.1. Revised with ACGIH TLV for 24 hrs. Verified new 2001 ACGIH TLVs.
06/08/01	<i>(Signature and date on file)</i> R. Selvey	Clarified wording on pre and post calibration to match IH51660.
04/09/04	<i>(Signature and date on file)</i> R. Selvey	Revised format in Section 7. Updated references to SBMS.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH96200
	REVISION FINAL Rev. 5
SUBJECT: Noise Measurement Principles: Area Surveys	DATE 04-09-04
	PAGE 9 OF 16

Attachment 9.1

Theory of Noise Measurements

Octave-band filters separate the noise into discrete frequency ranges typically centered from 31.5 Hz to 16 kHz in octave intervals. Separation of the noise into these frequency bands is useful in predicting the success of various forms of engineering controls and in predicting the potential harmful nature of noise to human speech frequencies.

Weighting on scales A, B, C and Flat is done to adjust the microphone characteristics to simulate the response of the human ear's response to sound (dBA) or to other response curves that are more characteristics of the true sound pressure level (dBB, dBC, and Flat). If the measured sound levels are much higher on the C-weighting than on the A- weighting, much of the noise is contributed by the low frequencies.

- *A Network*: Simulates the response of the human ear to noise. Generally used in noise surveys to locate noise hazards. The A Network discriminates against the low frequencies quite severely as does the human ear. Most regulations require that noise be measured on the A-weighting scale.
- *B Network*: Moderately discriminates against low frequencies
- *C Network*: Barely discriminates against low frequencies. Nearly a flat response.
- *Flat*: No filtering of the incoming pressure signal, i.e., a flat response.

Microphone signal decay can be set to FAST, SLOW, IMPACT and IMPULSE response. Employee exposure is made on Slow response. Impact is used for single bursts such as a weapon shot.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH96200
	REVISION FINAL Rev. 5
SUBJECT: Noise Measurement Principles: Area Surveys	DATE 04-09-04
	PAGE 10 OF 16

Attachment 9.2

BNL Program Administrator Guidance on Hazard Assessment and Exposure Monitoring

- 1.0 **Occupational Exposure Periodic Surveys-** Periodic surveys are done to determine compliance with occupational exposure standards based on measurement of employee exposure to noise.

Assessment of high noise areas should be done with Sound Pressure Level (SPL) measuring devices including Survey Meters and/or Personal Noise Dosimeters. Selection of the appropriate type of equipment shall conform to specifications established in SHSD IH Group IH96 series SOPs and to the requirements cited in OSHA and ANSI standards.

- All equipment should be calibrated as per IH51600.
- Initial assessment should be done at the installation and start of operation or for any equipment in operation that has not been previously evaluated by measurement or analogy to existing representative equipment.
- Surveys should be re-done, optimally on an annual basis, but at no more than a three-year interval.
- Surveys should be re-done if equipment or operation changes are made that could affect the noise level.

- 2.0 **Source and Area Measurements-** Ambient and source noise measurement for determining high noise areas may be included in the periodic survey program. Measurements are made in suspect areas to determine the intensity, frequency, and pattern of noise to:

- Determine if excessive noise is present and annual surveys are needed,
- Determine parameters for engineering control measures.

The devices used will typically be Survey Meters and Octave Band Analyzers. Selection of the appropriate type of equipment shall conform to specifications established in SHSD IH Group IH96 series SOPs and to the requirements cited in OSHA and ANSI standards.

Ambient and source noise measurement typically need to be re-done only when equipment or operation changes are made that could affect the noise level.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH96200
	REVISION FINAL Rev. 5
SUBJECT: Noise Measurement Principles: Area Surveys	DATE 04-09-04
	PAGE 11 OF 16

3.0 Use of Survey Meters (Broad Band) for employee exposure measurements-

A Survey meter can be used to determine the SPL TWA in the area for compliance monitoring, when noise levels in the area to be surveyed are:

- Uniform throughout the area,
- Constant throughout the work period, and
- Exposed personnel are not highly mobile within the workarea and remain in the area throughout the exposure period and do not enter and leave the area while performing typical work assignments.

Measurements should be made that are representative of exposure throughout the work shift by means of:

- multiple readings taken at intervals during the work day or
- datalogging.

Readings should be averaged on a time-weighted basis for the period of measurement or for the full shift as is appropriate based on the noise source.

The meter should be located at worker ear level in a placement that characterizes the worker exposure while performing typical work activities. The instrument should be operated in the A-weighted scale, on slow response.

Survey meters made also be used to take instantaneous measurements of noise pressure levels for identification of high noise areas, and for taking measurements aimed at locating noise sources. In these cases, simulation of full work shift exposure and worker exposure is not necessary.

4.0 Octave Band Analyzers (OBA)-

OBAs should be used for analysis of noise sources to determine the range of frequency and pressure level in each octave range. This data is used for determining appropriate engineering control and determining the potential for damage in human speech frequencies. The OBA should be operated as a survey tool and attempts to correlate to worker exposure and duration are not mandatory.

The only official copy is on-line at the SHSD IH Group website.
Before using a printed copy, verify that it is current by checking the document issue date on the website.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH96200
	REVISION FINAL Rev. 5
SUBJECT: Noise Measurement Principles: Area Surveys	DATE 04-09-04
	PAGE 12 OF 16

Attachment 9.3

Sound Pressure Level Survey Form (2 sided, 2 page form)

Attachment 9.4

Employee Notification Form (1 page form)

Attachment 9.5

Exposure Database Entry Form (1 page form)

(see next 4 pages)

BROOKHAVEN NATIONAL LABORATORY <small>ENVIRONMENTAL Safety Health and Qualification Directorate</small>		SOUND PRESSURE LEVEL SURVEY NOISE MEASUREMENT FORM
DATE:	SURVEYOR(S):	

I. AREA INFORMATION		
DEPT:	BLDG:	ROOM:
SOURCE:		
ENGINEERING CONTROLS:		

II. EMPLOYEE INFORMATION		
FIRST NAME:	LAST NAME:	BNL #:
DEPT:	BLDG:	JOB TITLE:
EXPOSURE DURATION (HRS):	EXPOSURE (TIMES PER DAY):	EXPOSURE (DAYS PER YR):
JOB PERFORMED:		
PPE USED:		

III. SURVEY INSTRUMENT INFORMATION												
INSTRUMENT:	MODEL:						SERIAL#:					
FACTORY CALIBRATION DATE:	PRE-CAL: BY:						POST CAL: BY:					
BATTERY CHECK (Y/N):	125 250 500 1000 2000						125 250 500 1000 2000					
CALIBRATOR SERIAL #:	dBA						dBA					
	dBC						dBC					

IV. SAMPLING INFORMATION & RESULTS				
Response: <input type="checkbox"/> FAST <input type="checkbox"/> SLOW WIND SCREEN: Y N				
TIME	LOCATION OF SAMPLE READING	SPL READING		COMMENTS, SPECIAL CONDITIONS, and/or STATUS OF SOURCE
		dBA	dBC	
<input type="checkbox"/> Additional Data on back of form				

V. CONCLUSIONS & RECOMMENDATIONS	
Return completed form to: SHSD IH Lab	
FILE CODE: IH96SR. FORM IH96200 9.2 (03/01)	

IV. SAMPLING INFORMATION & RESULTS (continued)

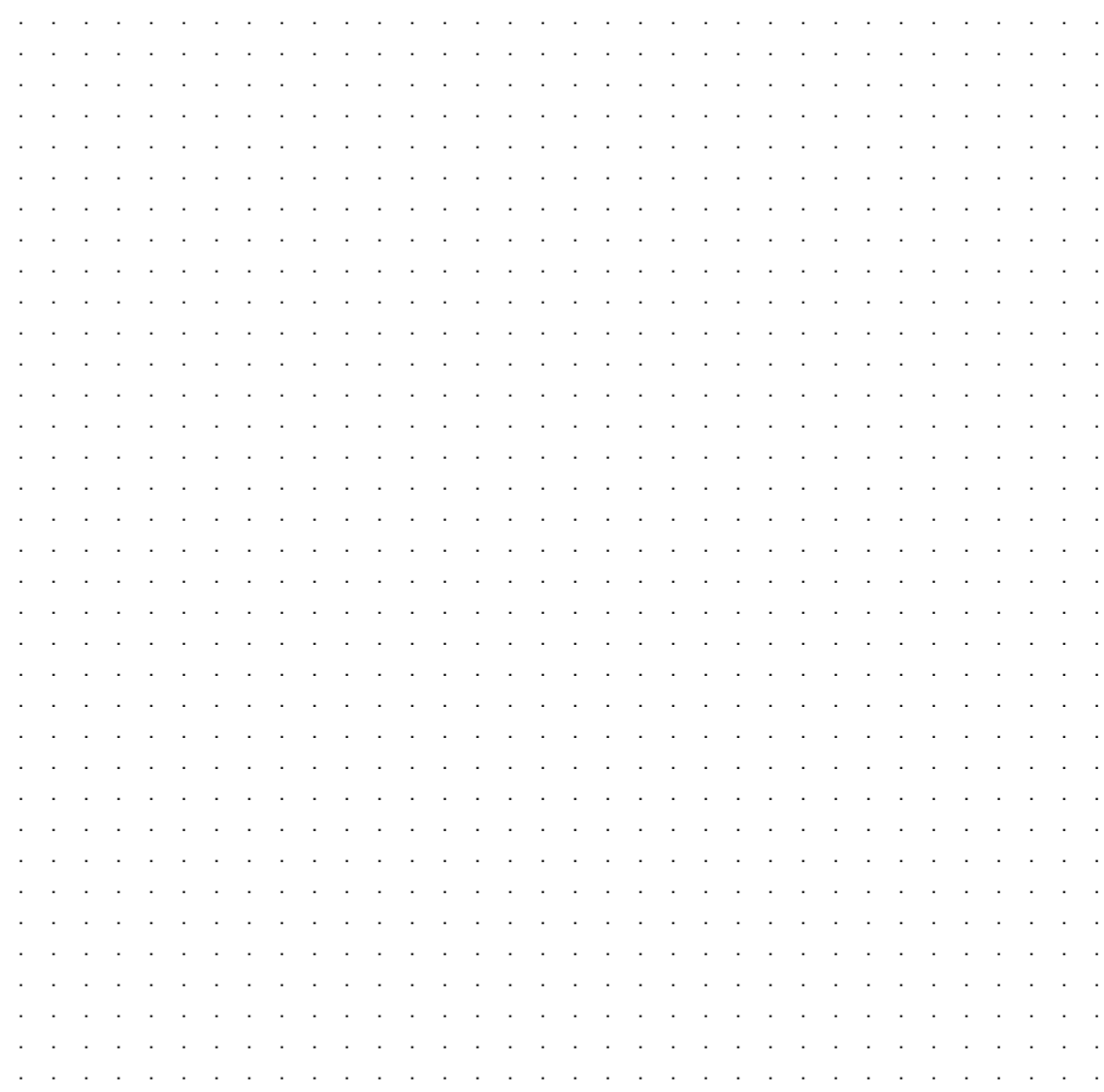
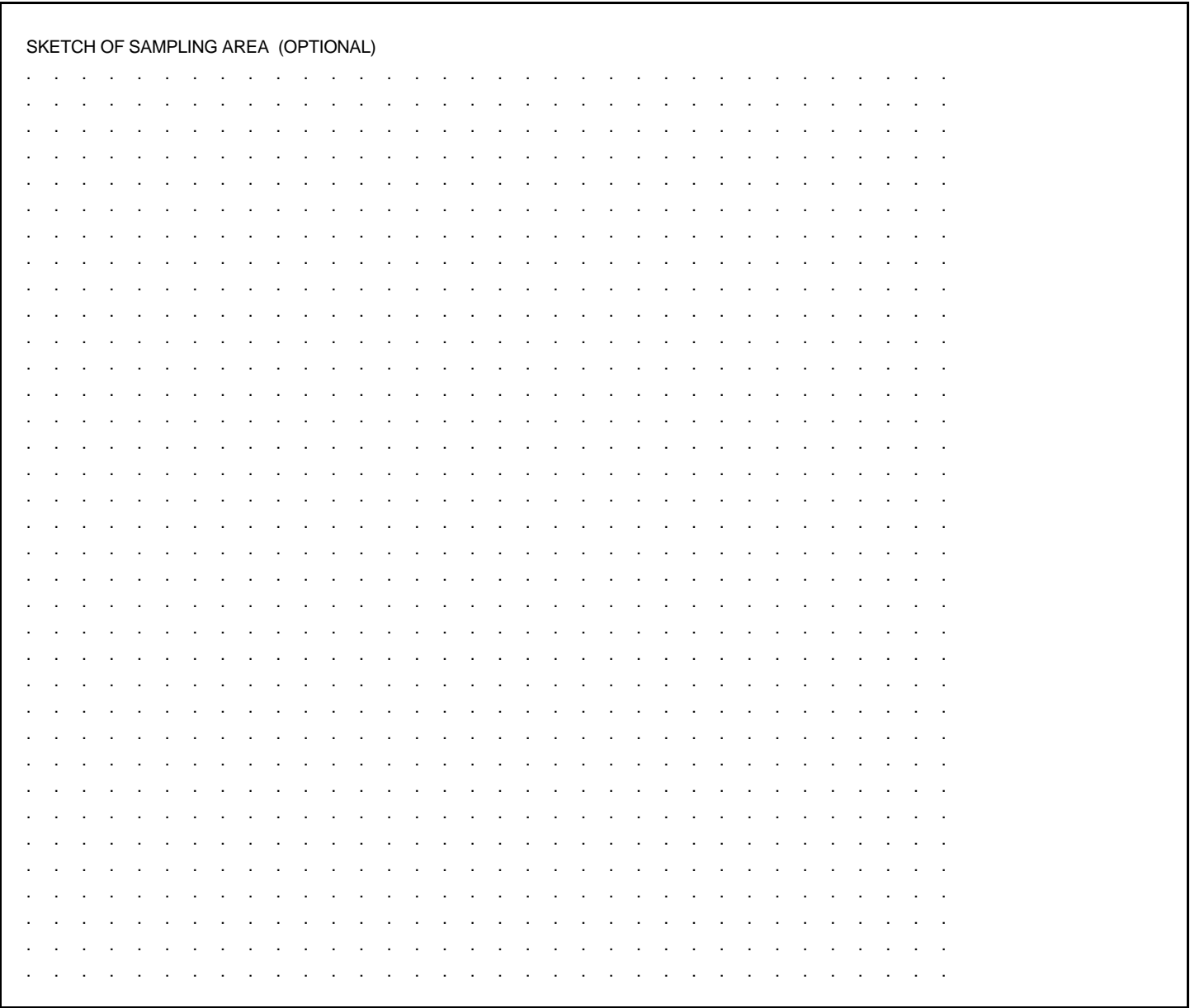
Response: ☐FAST ☐SLOW WIND SCREEN: Y N

Response: ☐FAST ☐SLOW WIND SCREEN: Y N

[illegible]

Additional Data on back of form

SKETCH OF SAMPLING AREA (OPTIONAL)

A large grid of dots for sketching a sampling area. The grid consists of 20 columns and 20 rows of small dots, providing a space for drawing or marking a specific area of interest.

**Exposure Monitoring
Employee Notification Record**

This Section to be completed by Sample Submitter	
Send results to Responsible Party:	Name: _____ Building: _____ <i>Responsible Party will be expected to notify over exposed workers of monitoring results.</i>
Send copy to:	Name: _____ Building: _____
Send copy to:	Name: _____ Building: _____
Send copy to:	Name: _____ Building: _____
Copy to IHG:	_____Horn ____Peters _____ Selvey _____Bernholc

This section to be completed by the Industrial Hygiene Group	
Data Received from Sampler:	Date: _____ Hour: _____
Hardcopy of sent to Responsible Party:	Date: _____ Hour: _____
Phone call to Responsible Party:	Date: _____ Hour: _____
Report sent By:	_____Wilson _____ Selvey _____Bernholc _____Horn

Notification to employee must be made by:	Date	Galson Login#	Asbestos CofC#:
		N/A	N/A

This Section to be completed by the Responsible Party before date above (within regulatory set time periods).	
Exposure in Compliance within Standards (ACGIH & OSHA) Employee Notification Review of this data indicates exposure levels were in compliance with regulatory limits. The employees represented by this exposure monitoring were informed of the results by: Name: _____ Date: _____ Informed by: _____	Exposure exceeds Standards (ACGIH or OSHA) Employee Notification Review of this data indicates exposure levels were ABOVE a regulatory limit. The employees represented by this monitoring were informed of the results and corrective actions. Name: _____ Date: _____ Informed by: _____
Note: If a formal BNL Memorandum is written, send a copy to the SHSD Industrial Hygiene Group (Building 129) and the Occupational Medicine Clinic (Building 490).	

**Return this form to the Industrial Hygiene Group (Building 129)
as soon as employee notification is made.**

BROOKHAVEN NATIONAL LABORATORY ESH&Q Directorate

INDUSTRIAL HYGIENE MONITORING

Date		
Dept.		
Building		
Source/Job		
First Name		
Last Name		
Life#		
Area Sampled		
Contaminant	NOISE	
Concentration		
Units	_____dBA _____dBC	
Time of Exposure (min)		
Sample Technique	<u> X </u> Direct Reading Meter	
Sample By:		
Comments		
Data Entry		Date:

_____ Multiple entries follow